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**FLAX VARIETIES AND WEED CONTROL FOR ORGANIC
FARMING PRODUCTION**

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Flax Varieties and Weed Control for Organic Production

2003-06

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Abstract

Early flowering combined with delayed seeding were investigated to determine if pre-seeding tillage could be effective for organic or pesticide-free flax production. Of nine early flowering flax lines, 2 supported the potential of the idea. However, June 1 seeding resulted in the highest seed yields and early flowering was not a factor in this result. A second experiment confirmed the benefit of pre-seeding tillage for delayed seeding up to June 1. A combination of late May to early June seeding combined with an early flowering variety should be considered for organic or pesticide-free flax production. All of the early flowering lines have been prepared and tested for possible variety evaluation but only lines 5 and 6 offer much potential.

Executive Summary

Delayed seeding of flax combined with pre-seeding tillage may be the only practical alternative for the organic production of flax. Nine flax populations selected for earlier flowering along with three standard varieties, Vimy, CDC Bethune and CDC Normandy, were planted in a date of seeding study at Scott and Saskatoon from 2003-2005, and Melfort in 2005 to evaluate the effect of early flowering on seed yield. Flax yields did not differ significantly if seeding was delayed from May 15 to June 1; however, yield declined on average by 54% when seeding was delayed until June 15. Bethune was the highest yielding cultivar when seeded at the May 15 and June 1 seeding dates; however the earlier flowering lines were the highest yielding when seeded on the June 15 seeding date. Although the earlier flowering lines were the highest yielding at the June 15 seeding date, their yields did not equal the yields obtained at the earliest seeding dates in most cases.

A second experiment which investigated the interaction between seeding date (May 15, June 1, June 15) and weed control system (pre-seeding tillage, pre-seeding glyphosate burnoff, and a pre-seeding glyphosate / in-crop herbicide combination) was conducted at Scott and Saskatoon from 2003-2005. The best organic or pesticide-free treatments were obtained at the June 1 seeding date since it provided the best weed control and highest yields. Delayed seeding later than June 1 was not beneficial as yields and weed control were not improved. Organic or pesticide-free producers should consider using an early flowering cultivar and delay seeding until most weeds are emerged (late May / early June). This allows for an efficacious pre-seeding weed control treatment to be applied which will minimize weed interference with the crop.

The nine early flowering populations were all lined out and preliminary Breeder Seed produced over the three year period of the grant. Thus seed is available for release of any of the nine as a variety. However, yield testing in 2005 at 3 locations plus the results from Experiment 1 suggest that lines 5 and 6 are the only two worth proceeding for variety registration.

Background

Organically grown flax generally receives a significant price premium over conventionally produced flax, making it an attractive crop for organic growers. Flax is a

poor weed competitor, thus weed control is a major issue in the production of organic flaxseed. Delayed seeding of flax so that the first flush of weeds can be controlled by tillage is one method of weed control available to organic producers. Delayed seeding of flax can result in late maturity, which may reduce both yield and seed quality. We hypothesize that early flowering flax cultivars can be developed that when seeded in early June will mature at the same time as conventionally seeded and standard grown flax varieties. We further hypothesize that the early flowering types, combined with shallow pre-seeding tillage, should become established quickly in the warmer soils of early June. This should result in fast growth to provide weed competition. The end result with these varieties should be good flaxseed yield and quality when grown under organic production systems. Two experiments were conducted at Saskatoon and Scott to test these hypotheses. The first study evaluated the performance of 12 flax cultivars (9 advanced breeding lines, 3 checks) at three seeding dates (May 15, June 1, June 15). This date of seeding test was also conducted at Melfort in 2005. The second experiment evaluated the interaction of seeding date (May 15, June 1, June 15) with weed management system (pre-seed tillage, pre-seed glyphosate burnoff only, and a pre-seed glyphosate /post-emergence herbicide combination).

Experiment 1: Flax Cultivar X Seeding Date

Methods and Materials

Nine advanced breeding lines (see Experiment 3, Table 1 for pedigrees) that were selected for early flowering as well as three checks (CDC Bethune, CDC Normandy, and Vimy) were seeded at three seeding dates (May 15, June 1, and June 15) at the Kernen Research Farm at Saskatoon (2003-05), the Scott Research Farm (2003-05) and Melfort Research Farm (2005). The 2004 study at Scott was abandoned due to poor emergence. The experiment was conducted on summerfallow at all locations. The experimental design was a split-plot with seeding date and cultivar the main and sub-plot factor, respectively. Each treatment was replicated 4 times. To ensure adequate plant stands, a target density of 600 viable seeds m^{-2} was planted at all locations. At Scott, plots were seeded with a hoe-drill with a 22 cm row-space and equipped with on-row packing. Plots were seeded in Saskatoon and Melfort with a hoe-drill with an 18 cm row-space. Plots were fertilized according to soil test. Plots received a pre-seed tillage or pre-seed glyphosate prior to each seeding date. Weed control was applied as required. Plots were straight combined at maturity and seed samples were collected and dried to constant moisture. Common data collected at both sites were plant stand (plants per m^{-2}), days to first flower, and crop yield

Combined and individual site data was analyzed according to statistical design using the PROC MIXED procedure of SAS.

Environmental data

Environmental data is summarized in Table 1:

2003

Both Saskatoon and Scott received below-normal precipitation. Soil moisture was adequate in early spring which allowed for good seeding conditions. The growing season at both locations was warmer than normal.

2004

Scott received below normal precipitation while Saskatoon received above normal precipitation. Both sites had below normal growing season temperatures.

2005

All sites received greater than 1.6 times the long-term normal precipitation. Growing season temperatures were only slightly below the long-term normal.

Table 1: Growing season precipitation (mm) and mean monthly temperatures (° C) at Scott, Saskatoon and Melfort, 2003 to 2005 and long-term averages..

<i>Precipitation (mm)</i>		<u>April</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>August</u>	<u>Sept</u>	<u>Total</u>
<i>Scott</i>								
	2003	24	22	34	66	44	43	233
	2004	3	35	53	69	44	15	219
	2005	27	41	100	77	88	75	408
	Scott Long-Term Average	23	36	60	59	45	32	255
<i>Saskatoon</i>								
	2003	61	14	31	64	31	39	240
	2004	18	36	87	75	73	23	312
	2005	6	31	193	37	81	102	449
	Saskatoon Long-Term Avg.	14	47	61	60	39	29	250
<i>Melfort</i>								
	2005	13	37	166	70	99	97	482
	Melfort Long-Term Avg.	25	46	66	76	57	27	297
<i>Mean Monthly Air Temperature (° C)</i>		<u>April</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>August</u>	<u>Sept</u>	<u>Mean</u>
<i>Scott</i>								
	2003	4	11	15	18	20	10	13.0
	2004	5	8	13	17	14	10	11.2
	2005	5	9	13.5	18	13	10	11.4
	Scott Long-Term Average	3	10	14	17	16	10	11.8
<i>Saskatoon</i>								
	2003	5	12	16	18	21	11	13.7
	2004	6	8	13	17	14	12	11.7
	2005	4	11	15	18	16	12	12.6
	Saskatoon Long-Term Avg.	5	12	16	18	18	12	13.3
<i>Melfort</i>								
	2005	6	9	14	17	15	11	11.9
	Melfort Long-Term Avg.	3	11	16	18	16	11	12.5

Results and Discussion

Plant Stand

Results for the ANOVA are reported in Table 2.

Overall plant stands achieved were very good at all sites. When combined across all sites, seeding near May 15 resulted in the highest plant stands (Table 3); however, there was a site-year by seeding date interaction. In 2005, early seeding had a very large benefit in Saskatoon (Table 3). At Melfort, the first two seeding dates resulted in the highest plant densities while Scott had slightly higher densities at the later seeding dates. At Saskatoon in 2004, plant densities were highest when seeded on May 15 with lower densities recorded at the later seeding dates. In 2003, average plant stands were 434 and 313 plants m⁻² for Saskatoon and Scott, respectively with highest plant stands achieved at the latest seeding date, due to rainfall received close to the seeding date (Table 3). Plant densities would be considered adequate at all site-years to provide acceptable yields, thus differences in seeding date yields would be due to factors other than plant establishment.

There were cultivar differences as well (Table 4). However, most of the differences are attributed to the checks CDC Bethune and Normandy having higher seed quality than some of the experimental lines, primarily in 2003 and 2004 (data not shown). Density of all cultivars was considered adequate; therefore, yield comparisons can be based on genetic potential. There were seed date by cultivar interactions (Table 2), but it is unlikely that these interactions are of any biological significance.

Table 2: *p* values for Analysis of Variance of Flax Cultivar X Seeding Date experiment. Six site years - Scott (2003, 2005), Saskatoon (2003-2005) and Melfort (2005).

Source	Plant Stand	Days to Flowering	Seed Yield
Seed Date	< 0.0001	< 0.0001	< 0.0001
Cultivar	< 0.0001	< 0.0001	< 0.0001
Seed Date*Cultivar	0.0001	< 0.0001	< 0.0001
Site-Year * Seed Date	< 0.0001	< 0.0001	< 0.0001
Site-Year * Cultivar	< 0.0001	< 0.0001	< 0.0001
Site-Year * Seed Date*Cultivar	0.10	< 0.0001	0.36

Table 3: Effect of seed date on flax plant stand at six sites - Scott (2003, 2005), Saskatoon (2003-2005) and Melfort (2005). Mean of 12 flax cultivars.

Seed Date	All sites	Plant stand (plants m ⁻²)					
		Scott 2005	Saskatoon 2005	Melfort 2005	Saskatoon 2004	Scott 2003	Saskatoon 2003
May 15	357	112	655	280	354	318	421
June 1	327	185	545	311	247	258	420
June 15	289	145	329	178	239	363	461
LSD _{0.05}	17	19	42	78	36	69	18

Table 4: The effect of flax cultivar on plant stand establishment. Mean of 3 seeding dates (May 15, June 1, and June 15) and six site-years - Scott (2003, 2005), Saskatoon (2003-2005) and Melfort (2005). Cultivars are presented in terms of ranking.

All sites	
Cultivar	Plants m ⁻²
Normandy	423
3	387
Bethune	382
2	367
6	361
1	360
7	354
9	340
4	337
8	331
5	330
Vimy	306
LSD _{0.05}	18

Days to Flowering

When combined across site-years, delayed seeding past June 1 reduced days to flowering by 6 days, on average (Table 5). The earliest flowering line over all seed dates was line 5, followed by 2 and 6. The days to flowering for line 5 was reduced by 11 days when seeding was delayed from May 15 to June 15. Comparatively, days to flowering for the checks Vimy, Bethune and Normandy were reduced by 8, 3, and 9 days, respectively when seeding date was delayed from May 15 to June 15. Therefore, not only did line 5 flower earliest, the days to flowering were accelerated when seeding was delayed.

Flax seed yield

Effect of seeding date

When combined across site-years, yields of flax were similar when seeded on May 15 to June 1 (Table 6). The yield of flax declined by 54% when seeding was delayed until June 15; however, there was considerable variation between site-years. Seeding on June 15 resulted in a 10 and 90% yield reduction at the Saskatoon and Scott sites in 2005, respectively (Table 7). Part of the reason for the high yield reductions at Scott in 2005 was due to a heavy hail storm that occurred in mid-July.

Interaction of cultivar and seeding date

The combined analysis ranked Bethune as the highest yielding cultivar at the first two seeding dates (Table 6). When seeding was delayed until June 15, the highest ranking line was #5, the earliest flowering cultivar. Another early flowering line, #6 was ranked second for both the June 1 and 15 seeding dates. There were some differences between site-years for seeding date and cultivar responses; however, there was no site-year X seeding date X cultivar interaction (Table 2).

Table 5: Interaction of seed date and cultivar on days to flowering of flax. Mean of six site-years - Scott (2003, 2005), Saskatoon (2003-2005) and Melfort (2005). Cultivars are ranked from earliest flowering to latest at each seeding date.

May 15			June 1			June 15		
Rank	Cultivar / Line	Days to Flower	Rank	Cultivar / Line	Days to Flower	Rank	Cultivar / Line	Days to Flower
1	5	64	1	5	57	1	5	55
2	2	65	2	2	58	2	2	57
3	6	65	3	6	59	3	6	57
4	Vimy	66	4	Vimy	59	4	Vimy	58
5	9	66	5	9	59	5	9	59
6	3	67	6	4	60	6	Normandy	59
7	Bethune	67	7	3	60	7	3	60
8	4	67	8	Bethune	60	8	4	60
9	8	67	9	8	60	9	1	62
10	Normandy	67	10	Normandy	60	10	8	63
11	1	68	11	1	61	11	Bethune	64
12	7	69	12	7	63	12	7	65
Mean		66			60			60

Table 6: Interaction of seeding date and cultivar on yield of flax. Mean of six site-years - Scott (2003, 2005), Saskatoon (2003-2005) and Melfort (2005). Cultivars are ranked from highest to lowest yielding at each seeding date.

May 15		June 1		June 15	
Cultivar / Line	Yield (kg/ha)	Cultivar / Line	Yield (kg/ha)	Cultivar / Line	Yield (kg/ha)
Bethune	1641	Bethune	1618	5	815
8	1577	6	1566	6	790
7	1541	Vimy	1512	2	720
1	1536	9	1479	Bethune	683
Vimy	1521	1	1476	9	683
9	1516	5	1476	Vimy	680
Normandy	1511	Normandy	1469	8	672
6	1479	8	1469	1	661
5	1432	4	1447	4	657
4	1390	2	1405	3	650
2	1361	7	1388	Normandy	649
3	1338	3	1279	7	570
MEAN	1487		1465		686

Table 7: Interaction of seeding date and cultivar on yield of flax at Saskatoon and Scott, 2005. Cultivars are ranked from highest to lowest yielding at each seeding date.

<i>Saskatoon 2005</i>					
May 15		June 1		June 15	
Cultivar / Line	Yield (kg/ha)	Cultivar / Line	Yield (kg/ha)	Cultivar / Line	Yield (kg/ha)
1	2100	Bethune	2120	6	1842
8	2040	1	2050	5	1818
7	2021	7	1988	Bethune	1745
Bethune	2007	8	1912	8	1725
9	1896	6	1911	1	1700
Vimy	1895	Normandy	1908	4	1615
Normandy	1886	5	1835	2	1610
6	1807	9	1803	Normandy	1606
4	1700	Vimy	1799	Vimy	1605
3	1604	4	1793	3	1547
2	1538	2	1697	9	1537
5	1529	3	1519	7	1477
MEAN	1835		1861		1652
<i>Scott 2005</i>					
8	1922	6	1999	5	396
1	1905	Bethune	1996	6	311
Bethune	1873	1	1848	9	304
5	1826	2	1781	2	228
7	1747	5	1772	Vimy	210
Vimy	1740	8	1731	4	202
2	1662	4	1689	1	201
9	1657	Vimy	1688	Normandy	173
6	1645	Normandy	1588	8	136
Normandy	1630	9	1582	Bethune	116
4	1618	7	1422	3	114
3	1497	3	1355	7	63
MEAN	1727		1704		204

Relationship between days to flowering and flax seed yield

Regressing the days to flower against crop yield (combined data) resulted in a significant inverse linear relationship ($p=0.003$) for the June 15 seeding date only (Fig. 1). The trend ($p=0.16$) for the May 15 seeding date was an increase in yield with later flowering; however, no clear relationship was evident at the June 1 seeding date. At the June 15 seeding date, each day of later flowering resulted in a 16.3 kg/ha yield decline (Fig. 1).

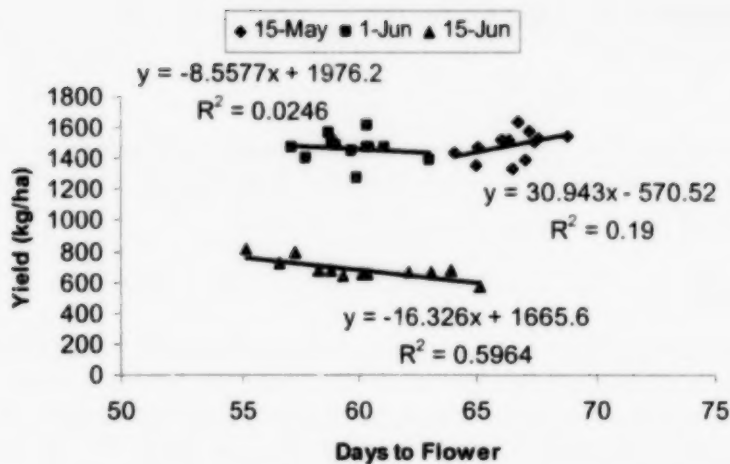


Figure 1: Relationship between days to flowering and flax seed yield at three seeding dates (May 15, June 1, June 15). Mean of six site-years - Scott (2003, 2005), Saskatoon (2003-2005) and Melfort (2005).

Conclusions

Flax yields did not differ significantly if seeding was delayed until June 1; however, in most cases yields declined sharply when seeding was delayed until June 15. Bethune was the highest yielding cultivar over the first two seeding dates; however the earlier flowering lines (5 and 6) were the highest yielding when seeded on the June 15 seeding date. While the earlier flowering lines were the highest yielding at the June 15 seeding date, their yields were not equal to yields obtained at the earliest seeding dates in most cases.

Experiment 2: Seeding Date x Weed Control x Flax Cultivar

Hypothesis

Pre-seeding tillage or a pre-seeding non-selective herbicide treatment combined with delayed seeding may result in adequate weed control for those involved in organic or pesticide-free production.

Methods and Materials

The experiments were conducted annually at Scott and Saskatoon from 2003 to 2005. Three different weed control treatments (pre-seed tillage only, pre-seed glyphosate burnoff only, and combined pre-seed glyphosate burnoff and in-crop herbicide) were applied to Vimy flax on three seeding dates (May 15, June 1, and June 15) at the Saskatoon Kernen Research Farm and the Scott Research Farm. The experiment was conducted on summerfallow at Scott and Saskatoon (2004-05) and wheat stubble at Saskatoon (2003). The experimental design was a randomized complete block and treatment design was factorial. Each treatment was replicated 4 times in plots that were 2 X 5 m, and 2 X 6 m in size at Scott and Saskatoon, respectively.

A mixture of wild oat, wild mustard, green foxtail and red-root pigweed seed was seeded across the experimental area with a disc drill. The area then received a shallow cultivation. Flax was seeded at 45 kg ha⁻¹. At Scott, plots were seeded with a hoe-drill with a 22 cm row-space and equipped with on-row packing. Plots were seeded in Saskatoon with a double-disc drill with a 20 cm row-spacing. Plots were fertilized according to soil test. Pre-seed burnoff treatments consisted of glyphosate at a rate of 450 g ai ha⁻¹. In-crop weed control was accomplished with Select and Buctril-M applied at recommended growth stages at rates of 47 and 560 g ai ha⁻¹, respectively. A plot combined harvested a strip down the center of each plot maturity and seed samples were collected and dried to constant moisture. Common data collected at both sites were plant stand (plants per m²), flax dry weight, weed dry weight and crop yield.

Combined data was analyzed using the PROC GLM procedure in SAS. Only the combined data is presented. There were site and year by treatment interactions; however, trends were similar over time so only combined data is presented.

Environmental conditions at each site were outlined in Experiment 1.

Results and Discussion

Plant stand

Seeding date was the only factor that had a significant effect on plant stand ($p < 0.0001$). The first two seeding dates had higher plant densities than the June 15 seeding date (Table 1). This is likely due to the drying of the soil surface from pre-seeding weed growth and/or water evaporation from the soil surface. Plant stands would still be considered adequate for the June 15 seeding date. Adequate plant stands were achieved at all site-years (data not shown).

Table 1: Effect of seeding date on flax plant stand at Scott and Saskatoon, SK. 2003-2005.

Seeding Date	Plants m ⁻²
May 15	320
June 1	332
June 15	271
LSD _{0.05}	18

Weed Dry Weight

There was a significant seeding date X weed control interaction for weed biomass ($p=0.063$). Highest weed biomass was recorded at the May 15 seeding date, since most of the weeds had not emerged at the time of the pre-seeding treatments (Fig. 1). The pre- and post- herbicide combination resulted in similar weed biomass at the three seeding dates. Delaying seeding until June 1 improved weed control with the two pre-seeding treatments. Further delay until June 15 resulted in higher weed biomass compared to June 1 for the two pre-seeding treatments, primarily due to the large size of the weeds at that time. This resulted in less effective weed control with either tillage or pre-seed glyphosate.

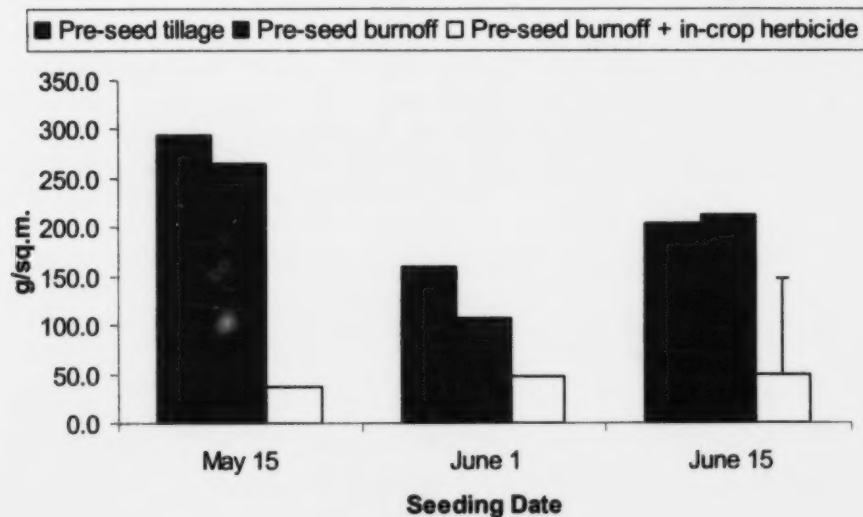


Figure 1: Interaction of seeding date and weed control treatment on total weed biomass (g m⁻²) in flax. Scott and Saskatoon, SK 2003-2005. . Bar represents the LSD_{0.05} to separate means for the seeding date X weed control interaction.

Flax Dry Weight

Seeding date and weed control treatment had significant effects on flax biomass (p values of <0.0001 for both factors); however, there was no seeding date X weed control interaction. Highest flax dry weight was recorded at the June 1 seeding date since pre-seed tillage and burnoff were more effective in reducing weed interference at this date (Table 2). The combined burnoff and in-crop herbicide treatment produced the highest

flax biomass over all seeding dates as it provided better weed control than the pre-seeding treatments. Pre-seed burnoff resulted in higher flax biomass than the pre-seed tillage treatments; likely due to slightly better weed control.

Table 2: Effect of seeding date and weed control treatment on crop dry weight (g m^{-2}). Scott. 2004. Scott and Saskatoon, SK 2003-2005.

	Pre-seed tillage	Pre-seed burnoff	Pre-seed burnoff + in-crop weed control	MEAN
May 15	180.1	209.7	297.5	229.1
June 1	268.8	323.9	407.8	333.5
June 15	211	291	309	270.5
MEAN	220.0	274.9	338.2	
LSD _{0.05}				27.5
**				

** Least significant difference to compare both seeding date and weed control means

Flax Yield

There was a significant seeding date X weed control treatment interaction for flax seed yield ($p < 0.0001$). Highest yields were achieved with the pre-seed and in-crop herbicide combination at the May 15 and June 1 seeding dates (Figure 2). The highest seed yields from the pre-seeding treatments were obtained at the June 1 seeding date. At the June 15 seeding date, none of the weed control treatments resulted in significantly different yields. Like Experiment 1, delayed seeding from June 1 to June 15 resulted in a 52 % yield reduction.

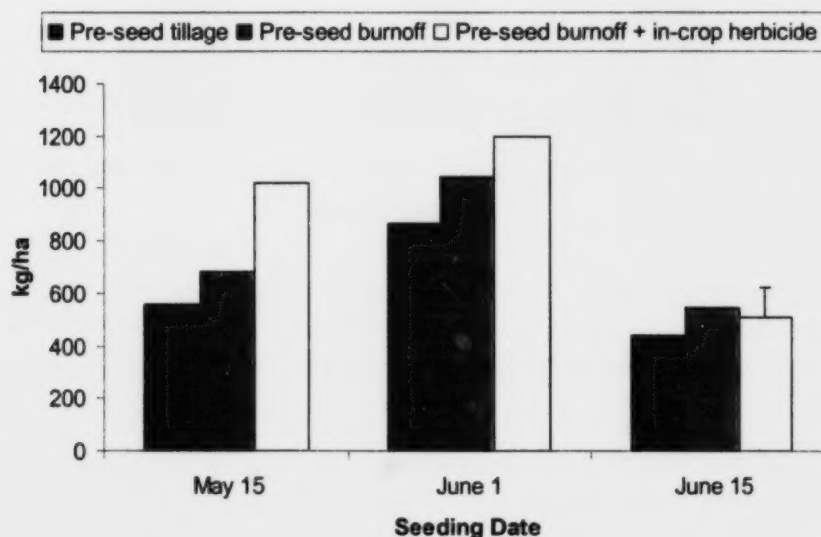


Figure 2: Interaction of the effects of seeding date and weed control system on flax seed yield (kg ha^{-1}). Scott and Saskatoon, SK 2003-2005. . Bar represents the $\text{LSD}_{0.05}$ to separate means for the seeding date X weed control interaction.

Conclusions

Delayed seeding until June 1 improved weed control and increases crop yields from either a pre-seed tillage or pre-seed burnoff. Delayed seeding beyond June 1 was not beneficial as yields and weed control were not improved.

Experiment 3: Breeding of Early Flowering Varieties for Organic Production

In 2002 there were 100 single plant selections made from each of the nine experimental F_5 populations. Each plant then became a single 3m long F_6 plant row at the Kernen Crop Research Farm in 2003 seeded. Within each population rows with the earliest flowering were identified. At the end of the season 3 plants were selected from each of these earlier flowering rows and these were seeded as individual F_7 'short rows' in 2004. The rows within each population were classified as to flowering date and vigour. Those with the earliest flowering date and the most vigorous were harvested as a single row. Seed from each of these rows was sent to the Agriculture and Agri-Food Canada Research Centre in Morden, Manitoba for rust testing. Seed from each rust resistant row within a population was seeded as a long row in 2005 and can serve as the beginning of Breeder Seed for a variety.

In addition to the lining out of each population, each population was increased to produce seed for the 2003 - 2005 Experiment 1. These lines, plus the checks (Table 1.) were grown in a 3 replicate yield trial grown at Saskatoon (Kernen Farm), Melfort and Young in 2005. The data from this trial plus another in 2006 will be required for entry of one or more of the lines into the Flax Cooperative Test.

Table 1. Varieties and early flowering lines used in for yield testing in 2005

Entry	Name	Pedigree
1	Virny	
2	Flanders	
3	CDC Bethune	
4	CDC Normandy	
5	ORGFX-1	98EMS1403//FP961/F91109
6	ORGFX-2	98EMS1403//DEU2879
7	ORGFX-3	98EMS1403//CZE2927
8	ORGFX-4	FP961/F91109//CZE2927
9	ORGFX-5	FP1048/FP2041
10	ORGFX-6	FP1048/FP1077
11	ORGFX-7	CDC Bethune/FP1077
12	ORGFX-8	CDC Bethune/FP2041
13	ORGFX-9	CDC Arras/FP1077

Not surprisingly CDC Bethune was the top yielding variety in this test (Table 2) as it is in most yield tests conducted in western Canada. This was consistent with what was found in Experiment 1. However, line 6 did quite well in the test as it also did Experiment 1 but its oil content is a little low. Line 5 is not significantly lower in seed yield, is earlier maturing and has better oil than line 6 and did very well in Experiment 1. Both of these

lines should be considered for additional testing. The wilt susceptibility of lines 2, 3 and 4 make them unsuitable for variety release.

Table 2. Average performance at Saskatoon, Melfort and Young in 2005.

Name	Yield (kg/ha)	Rank	1000 seed weight (g)	Height (cm)	Maturity score*	Lodging**	Oil (%)	Protein (%)	Iodine value
Vimy	1724	5	5.8	61	2.3	1.8	43.8	21.6	195
Flanders	1465	11	5.2	56	3.9	1.4	43.4	21.7	198
CDC Bethune	2021	1	5.6	58	2.1	1.6	44.1	21.7	191
CDC Normandy	1830	2	5.3	57	1.8	1.2	41.7	22.2	193
ORGF-1	1605	10	5.5	60	3.6	1.4	43.3	21.4	194
ORGF-2	1653	9	5.0	55	1.7	1.1	40.4	23.5	192
ORGF-3	1427	13	5.1	60	2.9	1.9	40.9	23.2	195
ORGF-4	1457	12	5.1	60	2.7	1.3	40.9	24.0	193
ORGF-5	1680	8	5.6	57	1.6	1.3	43.2	21.9	192
ORGF-6	1749	3	5.6	59	1.9	1.4	42.5	21.5	192
ORGF-7	1736	4	5.5	66	3.6	1.9	43.8	21.1	195
ORGF-8	1708	7	5.6	60	3.0	1.9	44.0	21.8	194
ORGF-9	1714	6	5.5	58	2.1	1.4	43.4	21.4	192
MEAN	1675		5.4	59	2.5	1.5	42.7	22.1	194
CV	14		3.1	7	23.9	31.0	1.5	2.1	1
LSD	179		0.1	3	0.5	0.4	0.4	0.3	1

* 1=early; 5=late

** 1=no lodging; 9=completely lodged

Conclusions

The results are supportive of the concept of developing early flowering lines of flax for organic or pesticide-free flax production. Some of these lines, i.e. 2, 5 and 6, should be useful parents for crosses aimed at improving the yield and oil characteristics of early flowering varieties.

Personnel Involved in the Project and Time Dedicated to the Project

E. Johnson, project scientist, AAFC, Scott, 5%
M. Greenwald, summer student, AAFC, Scott, 100% for summers of 2003-2005
R. Eppich, summer student, AAFC, Scott, 100% for summers of 2003-2005
A. Kapiniak, technician, AAFC, Scott, 33%
Bill Sullivan, AAFC, technician, AAFC, Melfort, 33%
S. Shirliffe, professor, Plant Sciences, U. of S., 5%
A. Miller, technician, Plant Sciences, U. of S., 33%
G. Rowland, professor, Crop Development Centre, U. of S., 5%
K. Armstrong, summer student, Crop Development Centre, U. of S., 100% for 4 months

ICAR Registration

Project no. 33331008 "Flax Varieties and Weed Control for Organic Farming Production"

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